

SECTION 16520

EXTERIOR LIGHTING SYSTEM

LANL MASTER CONSTRUCTION SPECIFICATION

When editing to suit Project, author shall add job-specific requirements and delete only those portions that do not apply to the Project (e.g., a component that does not apply). To seek a variance from applicable requirements, contact the Engineering Standards Manual (ESM) Electrical POC. Refer to http://engstandards.lanl.gov/engrman/HTML/poc_techcom1.htm#elec for the Engineering Standards Manual Personnel Link Index.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Delete information within "stars" during editing.

Specification developed for ML-3 / ML-4 projects. For ML-1 / ML-2, additional requirements and QA reviews are required.

PART 1 GENERAL

1.1 SECTION INCLUDES

Edit the following article to match project requirements.

A. Furnish and install the following:

1. Exterior luminaires and accessories
2. Lamps
3. Ballasts
4. Poles
5. Concrete foundations
6. Conduit and wiring
7. Lighting controls
8. Luminaire ballast fuses.

1.2 LANL PERFORMED WORK

A. None

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Provide luminaires, lamps, and ballasts suitable for operation at an elevation of 7500 feet above sea level and in the environment in which they will be used.
- B. Provide poles suitable for use with a basic wind speed of 90 miles per hour.
- C. Provide finishes on poles and luminaires that are resistant to color change and chalking in the ultraviolet exposure at an elevation of 7500 feet above sea level.

1.4 DEFINITIONS

- A. Unless otherwise specified or indicated, terms used in this Section are as defined in the *National Electrical Code* or the *IESNA Lighting Handbook*.

1.5 SUBMITTALS

- A. Submit the following in accordance with [Section 01300](#), *Submittal Procedures*.
 - 1. Catalog Data: Submit catalog data describing poles, luminaires, lamps, and ballasts. Include data substantiating that materials comply with specified requirements. Arrange data for luminaires in the order of luminaire designation.
 - 2. Performance Curves/Data: Submit certified photometric data for each type of luminaire.
 - 3. Shop Drawings: Submit manufacturer's drawings for non-standard luminaires.
 - 4. Maintenance Data: Submit maintenance instructions for inclusion in the operations and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Comply with the *National Electrical Code* (NEC) for components and installation.
- B. Comply with the *New Mexico Night Sky Protection Act*.
- C. Provide luminaires listed and labeled by a nationally recognized testing laboratory (NRTL) for the application, installation condition, and the environments in which installed.
- D. Use manufacturers that are experienced in manufacturing poles, luminaires, lamps and ballasts similar to those indicated for this Project and have a record of successful in-service performance.

1.7 EXTRA MATERIALS

- A. Furnish the following extra materials matching products installed. Package with protective covering for storage and identify with labels describing contents.
 - 1. Provide 5 percent of quantity of high intensity discharge (HID) lamps of each type, but no fewer than two lamps of each type.
 - 2. Provide 1 percent of quantity of ballasts of each type, but not less than one of each type.

1.8 RECEIVING, STORING AND PROTECTING

- A. Receive, inspect, handle, and store products according to the manufacturer's written instructions and NECA/IESNA 501, *Recommended Practice for Installing Exterior Lighting Systems*.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Alternate products may be accepted; follow Section 01630 *Product Options and Substitutions*.

2.2 FINISHES

- A. Furnish luminaires, poles, and accessories with finishes that are resistant to fading, chalking, and other changes due to aging and exposure to heat and ultraviolet light. Acceptable finishes for metals are:
 - 1. Hot-dipped galvanized steel per ASTM A 123/A 123M.
 - 2. Brushed natural aluminum
 - 3. Anodized aluminum per AAMA 611, *Voluntary Specification for Anodized Architectural Aluminum*, Class I.
 - 4. Polyester TGIC powder coat per AAMA 2604, *Voluntary Specification, Performance Requirements and Test Procedures for High Performing Organic Coatings on Aluminum Extrusions and Panels* over chrome phosphate conversion coated aluminum.
 - 5. Polyester TGIC powder coat per AAMA 2604, *Voluntary Specification, Performance Requirements and Test Procedures for High Performing Organic Coatings on Aluminum Extrusions and Panels* over zinc phosphate conversion coated shot-blasted steel.
- B. Reject luminaires, poles, and accessories with finish having runs, streaks, stains, holidays and defects.

- C. Replace luminaires, poles, and accessories showing evidence of yellowing, fading, chalking, and other changes indicating failure during warranty period.
- D. Use stainless steel for exposed hardware.

2.3 EXTERIOR LUMINAIRES

- A. Furnish exterior luminaires that comply with requirements specified in this Section and in the luminaire schedule on the Drawings.
- B. Furnish metal parts free from burrs and sharp corners and edges.
- C. Furnish sheet metal components fabricated from corrosion-resistant aluminum, formed and supported to prevent sagging and warping.
- D. Provide doors and frames that are smooth operating and free from light leakage under operating conditions.
 - 1. Relamping shall be possible without the use of special tools.
 - 2. Doors, frames, lenses and diffusers shall be designed to prevent accidental falling during relamping and when secured in the operating position.
 - 3. Door shall be removable for cleaning or replacing lens.
- E. Provide luminaires with minimum reflecting surface reflectance as follows unless scheduled otherwise:
 - 1. White surfaces: 85 percent
 - 2. Specular surfaces: 83 percent
 - 3. Diffusing specular surfaces: 75 percent
- F. Provide lenses, diffusers, covers and globes as scheduled on the Drawings fabricated from materials that are resistant to yellowing and other changes due to aging or exposure to heat and ultraviolet radiation.
- G. Provide resilient gaskets in doors that are heat-resistant and aging-resistant to seal and cushion lens and refractor.
- H. Provide high intensity discharge (HID) luminaries that conform to UL 1598 - *Luminaires*.

2.4 HIGH PRESSURE SODIUM LAMPS

- A. Furnish high pressure sodium lamps that comply with requirements specified below and the luminaire schedule on the Drawings.

- B. Furnish lamps that conform to ANSI Standards, C78.42 *Guidelines for High-Pressure Sodium Lamps*.
- C. Manufacturers: General Electric, North American Phillips, Sylvania

2.5 HIGH PRESSURE SODIUM LAMP BALLASTS

- A. Provide high pressure sodium (HPS) lamp ballasts with associated capacitors and ignitors that comply with requirements specified below for lamps specified in this Section and in the luminaire schedule on the Drawings.
- B. Conform to UL 1029 - *High-Intensity-Discharge Lamp Ballasts* and ANSI C82.4 - *Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps*.
- C. Provide HPS ballasts with the following circuit types:
 - 1. Lamp rated 150 watts or less: lag type – high reactance autotransformer – high power factor (HX-HPF).
 - 2. Lamp rated 250 watts or greater: constant wattage autotransformer (CWA).
- D. Provide core and coil ballasts constructed with class H or higher insulation system that is vacuum impregnated with a 100 percent solids-based resin.
- E. Ballasts shall be designed to operate for at least 180 cycles of 12 hours off and 12 hours on, with lamp in an open or a short-circuited condition without undue reduction in ballast life.
- F. Provide ballast and ignitor combination that will reliably start HPS lamp to -40 C.
 - 1. Provide HPS ballasts with a solid-state ignitor/starter or accessory that will automatically deactivate if a lamp arc cannot be initiated after 10 to 12 minutes.
 - 2. Where scheduled on the Drawings, provide HPS ballasts for 150 watt and smaller lamps with an instant re-strike starter that will generate a multiple pulse to re-strike lamp arc after a momentary power interruption.
- G. Provide oil-filled capacitors having metal cans and circuit interrupter devices to prevent catastrophic failure. Provide bleeder resistor with each capacitor
- H. Manufacturer: GE Lighting

2.6 POLES AND ACCESSORIES

NOTE: Edit the following articles to match project requirements.

- A. Furnish poles and accessories that comply with requirements specified in this Section and the luminaire schedule on the Drawings.

- B. Conform to AASHTO LTS-4 *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*, including interim revisions.
- C. Provide pole, base and anchorage rated to carry the luminaires, supports, and appurtenances at the indicated height above grade without deflection or whipping with a basic wind speed of 90 mph.
- D. Provide mountings, fastenings and other appurtenances fabricated from corrosion-resistant materials that are compatible with poles and luminaires and will not cause galvanic action at contact points. Provide mountings that will correctly position luminaires to provide scheduled light distribution.
- E. Provide reinforced access handhole in wall of each metal pole.
- F. Provide a welded 1/2 inch grounding lug in each metal pole, accessible through the handhole.
- G. Provide metal poles with anchor type bases and galvanized steel anchor bolts, leveling nuts and bolt covers.
- H. Where poles are indicated are indicated as "breakaway" type on the Drawings, provide each pole with a frangible aluminum transformer base that meets the requirements of AASHTO LTS-4.
- I. Provide each non-breakaway metal pole with a metal base cover that covers the entire base plate and anchorage.

NOTE: Edit the following article to match project requirements; delete if steel poles are not used.

- J. Provide steel poles that are fabricated from tubing conforming to ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psi.
 - 1. Poles shall be one-piece construction up to 40 feet in length.
 - 2. Poles over 40 feet in length may be in two or more sections with overlapping joints.
 - 3. Provide steel poles with [hot dipped galvanized finish per ASTM A 123.][polyester TGIC powder coat per AAMA 2604, *Voluntary Specification, Performance Requirements and Test Procedures for High Performing Organic Coatings on Aluminum Extrusions and Panels* with color as scheduled on the Drawings over zinc phosphate conversion coated shot-blasted steel.]

NOTE: Edit the following article to match project requirements; delete if tapered aluminum poles are not used.

- K. Provide tapered aluminum poles that are fabricated from 5052-H34 alloy and conform to ASTM 13209.

1. Provide aluminum poles with [anodized finish per AAMA 611, *Voluntary Specification for Anodized Architectural Aluminum*, Class I, with color as scheduled on the Drawings.][polyester TGIC powder coat per AAMA 2604, *Voluntary Specification, Performance Requirements and Test Procedures for High Performing Organic Coatings on Aluminum Extrusions and Panels*, with color as scheduled on the Drawings over chrome phosphate conversion coating.]

NOTE: Edit the following article to match project requirements; delete if straight aluminum poles are not used.

- L. Provide straight aluminum poles that are fabricated from 6063-T6 alloy and conform to ASTM B 429 - *Standard Specification of Aluminum-Alloy Extruded Structural Pipe and Tube*.
 1. Provide aluminum poles with [anodized finish per AAMA 611, *Voluntary Specification for Anodized Architectural Aluminum*, Class I, with color as scheduled on the Drawings.][polyester TGIC powder coat per AAMA 2604, *Voluntary Specification, Performance Requirements and Test Procedures for High Performing Organic Coatings on Aluminum Extrusions and Panels*, with color as scheduled on the Drawings over chrome phosphate conversion coating.]

NOTE: Edit the following article to match project requirements; delete if wood poles are not used.

- M. Provide pressure treated wood poles that conform to ATIS Standard O5.1, *Specifications and Dimensions (for Wood Poles)*.
 1. Treatment material shall be copper naphthenate.
 2. Treatment shall conform to AWWA C4, *Poles - Preservative Treatment, Pressure Processes* for the wood species used.
 3. Bore, roof and gain poles before treatment.

NOTE: Edit the following article to match project requirements; delete if steel mast arms are not used.

- N. Provide steel mast arms that are fabricated from 2 inch pipe, continuously welded to pole attachment plate and have span and rise as indicated on the Drawings. Provide with same finish as pole.

NOTE: Edit the following article to match project requirements; delete if aluminum mast arms are not used.

- O. Provide aluminum mast arms that are tapered oval tubing, continuously welded to pole attachment plate and have span and rise as indicated on the Drawings. Provide with same finish as pole.

NOTE: Edit the following article to match project requirements; delete if metal pole brackets are not used.

- P. Provide metal pole brackets that are designed to match pole metal and finish. Provide cantilever brackets without underbrace, in the sizes and styles indicated on the Drawings, with straight tubular end section to accommodate the luminaire.

NOTE: Edit the following article to match project requirements; delete if wood pole brackets are not used.

- Q. Provide wood pole brackets that conform to ANSI C136.13 - *Roadway Lighting Metal Brackets for Wood Poles*.

NOTE: Edit the following article to match project requirements; delete if pole-top tenons are not used.

- R. Provide pole-top tenons that conform to IEEE C136.21 and are fabricated to support the luminaire indicated and are securely fastened to the pole top.

2.7 GROUNDING

- A. Provide grounding for exterior lighting using materials specified in Section 16060, *Grounding and Bonding*.
- B. Provide a 10 foot long, 5/8 inch diameter copper-clad ground rod at each pole.

NOTE: Edit the following article to match project requirements. Comply with exterior lighting system control requirements in LANL Engineering Standards Manual, Chapter 7, Section G4020. The building automation system may be used to good advantage instead of timeclocks and photocontrols for control of exterior lighting so long as LANL ESM functional requirements are met.

2.8 LIGHTING CONTROL EQUIPMENT

- A. Provide photoelectric relays to control exterior lighting as indicated on the Drawings.
 - 1. For photoelectric relays mounted on luminaires provide products that conform to UL 733, *Plug-in, Locking Type Photocontrols for Use with Area Lighting* with single-pole single-throw contacts arranged to fail in the "ON" position. For each luminaire provide a luminaire-mounted locking-type receptacle conforming to IEEE C136.10.
 - 2. For photoelectric relays not mounted on luminaires provide products conforming to either UL 773 or UL 773A, *Non-industrial Photoelectric Switches for Lighting Control*. Provide the photoelectric relays with single-pole double-throw contacts to switch mechanically-held contactors.

3. Photoelectric relay contacts shall be factory set to turn exterior lighting "ON" at or below 3 footcandles and "OFF" at 4 to 10 footcandles. A time delay shall prevent switching from transient light sources.
- B. Provide one or more time switches to control exterior lighting as indicated on the Drawings.
1. Provide mechanical astronomic dial type or electronic type time switch, arranged to turn "ON" at sunset and turn "OFF" at predetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with seasonal changes
 2. Provide time switch with either an automatically wound spring mechanism or an energy-storage capacitor to maintain accurate time for a minimum of 7 hours following power failure.
 3. Provide time switch with a double-throw contacts to switch mechanically-held contactors and a manual on-off bypass switch.
 4. Provide time switch with NEMA 3R housing if installed outdoors or NEMA 1 housing if installed indoors.
- C. Provide one or more multi-pole lighting contactors to control exterior lighting as indicated on the Drawings.
1. Provide mechanically-held or contactors that conform to NEMA ICS 2 *Industrial Controls and Systems: Controllers, Contactors, and Overload Relays*.
 2. Provide number of contacts as indicated on the Drawings or as required by the number of circuits to be controlled. Contacts shall have a minimum rating of 30 amperes at 277 volts AC per pole for ballast loads. Contacts shall be field-convertible from normally-open to normally-closed.
 3. Provide 120 volts AC operating coils.
 4. Provide contactor with NEMA 3R housing if installed outdoors or NEMA 1 housing if installed indoors.

2.9 FUSES AND FUSE HOLDERS

- A. Provide fuse overcurrent protection for each pole-mounted luminaire to isolate faulted ballasts from the lighting circuit.
1. Use 600 volt, Class CC, time-delay, current-limiting fuses.
 2. Select fuses rated between 200% and 300% of the luminaire ballast maximum current.
 3. Manufacturer: Bussman "LP-CC".

- B. Provide in-line fuse holders for installation in pole hand hole or transformer base.
 - 1. Use non-breakaway type fuse holders unless breakaway poles are indicated on the Drawings.
 - 2. Use breakaway type fuse holders where breakaway poles are indicated on the Drawings.
 - 3. Provide load and line terminal sizes and types corresponding to line and load conductor sizes and quantities.
 - 4. Provide insulating boots for both breakaway and non-breakaway fuse holders.
 - 5. Manufacturers: Ferraz Shawmut "FEC" for phase conductor(s), "FEBN" for neutral conductor.

2.10 RACEWAYS AND BOXES

- A. Provide conduit system for exterior lighting using materials specified in Section 16130 *Raceways and Boxes*.

2.11 BUILDING WIRE

- A. Provide wiring system for exterior lighting using materials specified in Section 16120 *Building Wire and Cable*.

PART 3 EXECUTION

3.1 EXISTING WORK

Delete this article when existing construction is not affected.

- A. Disconnect and remove abandoned exterior luminaires as indicated on the Drawings.
- B. Disconnect and remove abandoned luminaire poles and associated foundations as indicated on the Drawings.
- C. Maintain electrical circuit to existing exterior luminaires that are to remain active.
- D. Clean and repair existing exterior luminaires that are to remain or be reinstalled.

3.2 EXAMINATION

- A. Examine areas, spaces, and surfaces to receive exterior luminaire (s) or poles for compliance with installation tolerances and other conditions affecting performance of the product. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions, NECA/IESNA 501, and approved shop drawings.
- B. Locations of luminaires and poles shown on the Drawings are diagrammatic. Coordinate luminaire locations with building finishes, building structure, utility piping, security fences, and existing trees. Obtain approval for location changes through Contract Administrator.
- C. Set poles and luminaires plumb, square, level and secure.
- D. Install surface mounted luminaires directly to an outlet box which is supported from structure.
- E. Install lamps in luminaires in accordance with manufacturer's instructions.

3.4 CONCRETE FOUNDATIONS

- A. Construct concrete foundations with 4000 psi, 28 day concrete and reinforcing conforming to Section 03300, *Cast-In-Place Concrete*.
- B. Comply with details on the Drawings and manufacturer's recommendations for foundation dimensions, reinforcing, anchor bolts, nuts and washers.
- C. Position power conduits to terminate within the pole shaft area and one inch above the top of the foundation; refer to Section 16130, *Raceways and Boxes*.
- D. In addition to power conduits, install a 1 inch PVC conduit in the pole base for the ground lead described below.
- E. Cure concrete foundations for 7 full curing days before erecting poles.

3.5 POLE ERECTION

- A. Use fabric web slings to raise and set poles.
- B. Tighten anchor bolt nuts and other pole hardware to torque recommended by manufacturer.
- C. After pole is leveled, pack non-shrink grout between anchor base and concrete foundation to provide a full bearing surface.
- D. Set embedded poles to depth indicated on the Drawings, but not less than 1/6 of pole length below finish grade.
 - 1. Auger holes large enough to permit the use of tampers the full depth of the hole.

2. Backfill in 6 inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of the undisturbed earth.

3.6 GROUNDING

- A. Install grounding for exterior lighting using methods specified in Section 16060, *Grounding and Bonding*.
- B. Install a 10 foot long, 5/8 inch diameter copper-clad ground rod at each pole.

NOTE: Edit the following articles to match project requirements.

- C. Connect ground lug of metal pole to ground rod using a 6 AWG copper conductor.
- D. Ground metallic components of lighting unit with non-metallic pole to ground rod using a 6 AWG copper conductor.

NOTE: Edit the following article to match project requirements.

3.7 LIGHTING CONTROL SYSTEM

- A. Install exterior lighting control system components in accordance with the manufacturers' instructions. Have installation instructions available at the construction site.
- B. Install a HAND-OFF-AUTO selector switch in the control system to allow for testing of luminaires.
- C. Provide separate control of exterior lighting system as follows:
 1. Safety, security, pedestrian walkway, and roadway lighting: "ON" at dusk, "OFF" at dawn.
 2. Parking facility and landscape lighting: "ON" at dusk, "OFF" at predetermined time. Approximately 10 percent of parking lot lighting shall remain on until dawn for personnel security.

3.8 FUSES AND FUSE HOLDERS.

- A. Install fuse(s) and fuse holders in pole hand hole or transformer base for each luminaire.
 1. Install fuse holder and fuse in each phase conductor.
 2. Install fuse holder with permanently mounted dummy fuse in neutral conductor.
- B. Orient breakaway fuse holders so no energized conductors will be exposed in the event of a pole knockdown.

- C. Install insulator boots over fuse holders and tape wrap where conductor enters boot.

3.9 RACEWAYS AND BOXES

- A. Install conduit system for exterior lighting using methods specified in Section 16030, *Raceways and Boxes*.

3.10 BUILDING WIRE

- A. Install wiring for exterior lighting using methods specified in Section 16120, *Building Wire and Cable*.

3.11 FIELD QUALITY CONTROL

- A. Inspect each installed lighting unit for damage. Replace damaged luminaires, poles and components.
- B. Test installed luminaires for proper operation.
 - 1. Provide instruments to make and record test results.
 - 2. Replace or repair malfunctioning luminaires and components then re-test.
 - 3. Repeat procedure until all luminaires operate properly.
- C. Replace inoperative lamps.

3.12 ADJUSTING AND CLEANING

- A. Clean each luminaire inside and out, including plastics and glassware. Use methods and materials recommended by manufacturer.

NOTE: Edit the following articles to match project requirements.

- B. Aim adjustable luminaires to provide required light intensities as indicated on the Drawings or as directed by the Contract Administrator.
- C. Adjust exterior lighting controls to obtain the following performance unless otherwise indicated on the Drawings or directed by the Contract Administrator:
 - 1. Safety, security, pedestrian walkway, and roadway lighting: "ON" when ambient lighting becomes less than 1.6 times the illuminance design level or 1.5 footcandles, whichever is higher; "OFF" when ambient lighting exceeds approximately 5 foot candles.
 - 2. Parking facility and landscape lighting: "ON" when ambient lighting becomes less than 1.6 times the illuminance design level or 1.5 footcandles, whichever is higher; "OFF" at 10:00 p.m.

END OF SECTION

Do not delete the following reference information.

FOR LANL USE ONLY

This project specification is based on LANL Master Construction Specification Rev. 0, dated April 25, 2005.